IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Application of

Applicants : Stuart M. Lindsay et al.
Serial No. : 10/725,769
Filed : December 2, 2003
Title : **FAST SCANNING STAGE FOR A SCANNING PROBE MICROSCOPE**
Docket : 10060298-2
Examiner : Livedalen, Brian J.
Art Unit : 2878
Confirm. No.: 3836

MAIL STOP APPEAL BRIEF - PATENTS
Commissioner for Patents
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Sir:

BRIEF ON APPEAL

This is an appeal from the Office Action mailed May 7, 2008, rejecting claims 1-13 and 15 in the application. On July 25, 2008, a Notice of Appeal was filed via Electronic Filing System with the accompanying fee. In accordance with 37 CFR 41.37 an appeal brief is being timely filed with a separate request for a one month extension of time. An authorization to charge Agilent's deposit account in the amount of $540.00 (filing a brief in support of an appeal) accompanies this Brief in accordance with 37 CFR §41.20(b)(2).

Real Party in Interest

The real parties in interest in this application are Agilent Technologies, Inc. (1/2 interest) and Arizona Board of Regents (1/2 interest).

Molecular Imaging Corporation (1/2 interest) and Arizona Board of Regents (1/2 interest) recorded their assignments in this application in the files of the U.S. Patent and Trademark Office at Reel 014894, Frame 0004, on January 20, 2004. Molecular Imaging Corporation, in turn, assigned its half interest to Agilent Technologies, Inc. This assignment is recorded in the files of the U.S. Patent and Trademark Office at Reel 017527, Frame 0255, on April 26, 2006.

Related Appeals and Interferences

This application was the subject of a prior appeal filed via First Class Mail on June 21, 2006, US Patent Office Mail Room date June 27, 2006, and as a result prosecution was re-opened, see Non-Final Rejection mailed July 20, 2006. Therefore, no decision was rendered by the Board.

Status of Claims

Claims 1-13 and 15 are pending in this application; claim 14 was previously canceled. Claims 1-13 and 15 stand finally rejected and are before this Board for consideration on appeal. A copy of the appealed claims is found in the Appendix attached to this brief.

Status of Amendments

All of the amendments previously filed in this application have been entered.

Summary of Claimed Subject Matter

The following is a concise explanation of the subject matter defined in each of the independent claims and each of the dependent claims argued separately. Reference to the drawing figures and specifically depicted embodiments of the invention are for the convenience of the Board and are not to be interpreted as limitations on the claims.

In general, the claims relate to scanning probe microscopy such as, for example, atomic force microscopy or near-field optical microscopy. Embodiments of applicants' invention are directed to a fast scanning stage for a scanning probe microscope and a method of operating such a fast scanning stage. The stage permits acquisition of images at an improved rate in comparison to conventional scanning probe microscopes.

Claim 1

Independent claim 1 relates to "a fast scanning stage for a scanning probe microscope," one embodiment of which is shown in Figs. 2A-B and discussed beginning in paragraph [0024] on page 7, line 15. The scanning probe microscope includes a probe 24 (see paragraph [0014] on

page 5, lines 5-6; paragraph [0025] on page 7, line 29 through page 8, line 1; Fig. 2B). The fast scanning stage comprises a fixed support 23 and a sample stage 21 having at least one axis of translation (see paragraph [0013] on page 4, line 25; paragraph [0014] on page 5, lines 6-7; paragraph [0024] on page 7, lines 19-21; Figs. 2A-B). The sample stage 21 is affixed to the fixed support 23 by means for causing displacement of the sample stage 21 relative to the probe 24 (see paragraph [0024] on page 7, lines 19-21; Figs. 2A-B).

The structures and acts comprising the means for causing displacement of the sample stage 21 are at least one actuator element 22 supporting the stage 21 and a sine waveform generator 20 for actuating the at least one actuator element 22. These structures and acts are described in the Specification in paragraph [0014] on page 5, lines 9-11; paragraphs [0024]-[0025] on page 7, lines 19-28, and shown in Figs. 2A-B.

The means for causing displacement comprises actuator elements 22 extending between the fixed support 23 and the sample stage 21 (see paragraph [0014] on page 5, lines 9-11; paragraph [0024] on page 7, lines 19-22; Figs. 2A-B). The means for causing displacement is responsive to the application of a bias voltage of 100 volts or less (see paragraph [0012] on page 4, line 18; paragraph [0033] on page 10, line 26). The scanning probe microscope is a fast atomic force microscope (AFM) (see paragraph [0013] on page 4, line 24; [0034] on page 11, lines 1-2) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz (see paragraph [0006] on page 2, line 20; paragraph [0016] on page 5, lines 26-28; paragraph [0035] on page 11, lines 22-23).

Claim 2

Independent claim 2 relates to "a fast scanning stage for a scanning probe microscope," one embodiment of which is shown in Figs. 2A-B and discussed beginning in paragraph [0024] on page 7, line 15. The scanning probe microscope includes a probe 24 (see paragraph [0014] on page 5, lines 5-6; paragraph [0025] on page 7, line 29 through page 8, line 1; Fig. 2B). The fast scanning stage comprises a fixed support 23 and a sample stage 21 having at least one axis of translation (see paragraph [0013] on page 4, line 25; paragraph [0014] on page 5, lines 6-7; paragraph [0024] on page 7, lines 19-21; Figs. 2A-B). The sample stage 21 is affixed to the fixed

support 23 by means for causing displacement of the sample stage 21 relative to the probe 24 (see paragraph [0024] on page 7, lines 19-21; Figs. 2A-B).

The structures and acts comprising the means for causing displacement of the sample stage 21 are at least one actuator element 22 supporting the stage 21 and a sine waveform generator 20 for actuating the at least one actuator element 22. These structures and acts are described in the Specification in paragraph [0014] on page 5, lines 9-11; paragraphs [0024]-[0025] on page 7, lines 19-28, and shown in Figs. 2A-B.

The means for causing displacement of the sample comprises actuator elements 22 extending between the fixed support 23 and the sample stage 21 and a sine waveform generator 20 for actuating the actuator elements 22 (see paragraph [0014] on page 5, lines 9-11; paragraph [0024] on page 7, lines 19-22; paragraph [0025] on page 7, lines 26-28; Figs. 2A-B) through the application of a bias voltage of 100 volts or less (see paragraph [0012] on page 4, line 18; paragraph [0033] on page 10, line 26). The scanning probe microscope is a fast atomic force microscope (AFM) (see paragraph [0013] on page 4, line 24; paragraph [0034] on page 11, lines 1-2) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz (see paragraph [0006] on page 2, line 20; paragraph [0016] on page 5, lines 26-28; paragraph [0035] on page 11, lines 22-23).

Claim 3

Claim 3 depends from claim 2 and relates to the means for causing displacement of the sample stage 21 comprising four actuator elements 22 supporting the sample stage 21, which is shown in Fig. 2A and discussed in paragraph [0014] on page 5, lines 9-12 and in paragraph [0024] on page 7, lines 19-20.

Claim 4

Independent claim 4 relates to "a fast scanning stage for a scanning probe microscope," one embodiment of which is shown in Figs. 2A-B and discussed beginning in paragraph [0024] on page 7, line 15. The scanning probe microscope includes a probe 24 (see paragraph [0014] on page 5, lines 5-6; paragraph [0025] on page 7, line 29 through page 8, line 1; Fig. 2B). The fast scanning stage comprises a fixed support 23 and a sample stage 21 having at least one axis of

translation (see paragraph [0013] on page 4, line 25; paragraph [0014] on page 5, lines 6-7; paragraph [0024] on page 7, lines 19-21; Figs. 2A-B). The sample stage 21 is affixed to the fixed support 23 by actuator elements 22 extending between the fixed support 23 and the sample stage 21 (see paragraph [0024] on page 7, lines 19-21; Figs. 2A-B) and a sine waveform generator 20 for actuating the actuator elements 22 (see paragraph [0025] on page 7, lines 26-28; Fig. 2A), in which the sample stage 21 is displaced by the actuator elements 22 being driven at the frequency of resonant vibration (see paragraph [0014] on page 5, lines 9-11; paragraph [0024] on page 7, lines 19-22; Figs. 2A-B) through the application of a bias voltage of 100 volts or less (see paragraph [0012] on page 4, line 18; paragraph [0033] on page 10, line 26) corresponding to translation of the sample stage 21 with respect to the probe 24 (see paragraph [0024] on page 7, lines 19-21; Figs. 2A-B). The scanning probe microscope is a fast atomic force microscope (AFM) (see paragraph [0013] on page 4, line 24; paragraph [0034] on page 11, lines 1-2) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz (see paragraph [0006] on page 2, line 20; paragraph [0016] on page 5, lines 26-28; paragraph [0035] on page 11, lines 22-23).

Claim 5

Claim 5 depends from claim 4 and relates to the sample stage 21 having a square or rectangular configuration and to each corner of the sample stage 21 being supported by one of the actuator elements 22, which is shown in Fig. 2A and described in paragraph [0015] on page 5, line 16.

Claim 6

Claim 6 depends from claim 5 and relates to the actuator elements 22 forming a parallelogram scanning element, as described in paragraph [0025] on page 7, line 24.

Claim 7

Claim 7 depends from claim 6 and relates to the actuator elements 22 being connected electrically in parallel, as described in paragraph [0025] on page 7, lines 26-27.

Claim 8

Claim 8 depends from claim 2 and relates to at least one of the actuator elements 22 comprising a stack bending element 50, as described in paragraph [0034] on page 11, lines 2-5.

Claim 9

Claim 9 depends from claim 2 and relates to at least one of the actuator elements 22 comprising a PZT bimorph, as described in paragraph [0015] on page 5, line 18; paragraph [0024] on page 7, line 21; and paragraph [0029] on page 9, lines 13-14.

Claim 10

Claim 10 depends from claim 3 and relates to at least one of the actuator elements 22 comprising a PZT bimorph, as described in paragraph [0015] on page 5, line 18; paragraph [0024] on page 7, line 21; and paragraph [0029] on page 9, lines 13-14.

Claim 11

Claim 11 depends from claim 1 and relates to the sample stage 21 being comprised of a material selected from the group consisting of ceramics, heat resistant polymers, and anodized aluminum, as described in paragraph [0015] on page 5, lines 18-20 and paragraph [0024] on page 7, lines 15-18.

Claim 12

Independent claim 12 relates to "a scanning probe microscope including a probe and a fast scanning stage," one embodiment of which is shown in Figs. 2A-B and discussed beginning in paragraph [0024] on page 7, line 15. The fast scanning stage comprises a fixed support 23 and a sample stage 21 having at least one axis of translation (see paragraph [0013] on page 4, line 25; paragraph [0014] on page 5, lines 6-7; paragraph [0024] on page 7, lines 19-21; Figs. 2A-B). The sample stage 21 is affixed to the fixed support 23 by actuator elements 22 extending between the fixed support 23 and the sample stage 21 (see paragraph [0024] on page 7, lines 19-21; Figs. 2A-B) and supporting the sample stage 21 to cause displacement of the sample stage 21 (see paragraph [0013] on page 4, line 27; paragraph [0014] on page 5, line 9-10; Figs. 2A-B) relative

to the probe 24 (see paragraph [0024] on page 7, lines 19-21; Figs. 2A-B) through the application of a bias voltage of 100 volts or less (see paragraph [0012] on page 4, line 18; paragraph [0033] on page 10, line 26). The scanning probe microscope is a fast atomic force microscope (AFM) (see paragraph [0013] on page 4, line 24; paragraph [0034] on page 11, lines 1-2) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz (see paragraph [0006] on page 2, line 20; paragraph [0016] on page 5, lines 26-28; paragraph [0035] on page 11, lines 22-23).

Claim 13

Independent claim 13 relates to a "method of operating a fast scanning stage for a scanning probe microscope," one embodiment of which is shown in Figs. 2A-B and discussed beginning in paragraph [0024] on page 7, line 15. The scanning probe microscope includes a probe 24 (see paragraph [0014] on page 5, lines 5-6; paragraph [0025], page 7, line 29 through page 8, line 1; Fig. 2B). A sample stage 21 is provided having a sample thereon (see paragraph [0024] on page 7, lines 15-16) and causing displacement of the sample on the sample stage 21 relative to the probe 24 by actuating actuator elements 22 extending between the sample stage 21 and a fixed support 23 (see paragraph [0014] on page 5, lines 8-9; Figs 2A-B). The actuator elements 22 drive the sample stage 21 at the resonant frequency of the sample stage 21 using a sine waveform generator 20 (see paragraph [0014], page 5, lines 9-11; paragraph [0024], page 7, lines 19-22; paragraph [0025], page 7, lines 26-28; Figs. 2A-B) through the application of a bias voltage of 100 volts or less (see paragraph [0012] on page 4, line 18; paragraph [0033] on page 10, line 26). The scanning probe microscope is a fast atomic force microscope (AFM) (see paragraph [0013] on page 4, line 24; paragraph [0034] on page 11, lines 1-2) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz (see paragraph [0006] on page 2, line 20; paragraph [0016] on page 5, lines 26-28; paragraph [0035] on page 11, lines 22-23).

Claim 15

Claim 15 depends from claim 13 and relates to the resonant frequency of the sample stage 21 being about $1/100^{th}$ that of the resonant frequency of the probe 24, as described in paragraph [0016] on page 5, lines 26-28.

Ground of Rejection to be Reviewed on Appeal

The ground of rejection for review on appeal is:

Claims 1-6, 12 and 13 have been rejected under 35 U.S.C. 103(a) as being unpatentable over Funakubo (JP 62105440, see English translation) in view of Watanabe et al (US 5,371,365), Barrett (US 5,210,410) and Sarkar (US 6,806,991).

Argument

Rejection Under 35 USC § 103(a) as being unpatentable over Funakubo (JP 62105440, see English translation) in view of Watanabe et al (US 5,371,365), Barrett (US 5,210,410) and Sarkar (US 6,806,991).

To establish a prima facie case of obviousness, the Examiner must show, by reasoning or evidence, one or more of the following rationales: (A) Combining prior art elements according to known methods to yield predictable results; (B) Simple substitution of one known element for another to obtain predictable results; (C) Use of known technique to improve similar devices (methods, or products) in the same way; (D) Applying a known technique to a known device (method, or product) ready for improvement to yield predictable results; (E) "Obvious to try" - choosing from a finite number of identified, predictable solutions, with a reasonable expectation of success; (F) Known work in one field of endeavor may prompt variations of it for use in either the same field or a different one based on design incentives or other market forces if the variations are predictable to one of ordinary skill in the art; or (G) Some teaching, suggestion, or motivation in the prior art that would have led one of ordinary skill to modify the prior art reference or to combine prior art reference teachings to arrive at the claimed invention. See MPEP §2143 and *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 167 L.Ed.2d 705, 82 USPQ2d 1385 (2007). The Examiner has failed to establish any of the rationales set forth above to support his conclusion of obviousness.

A rejection based on §103 clearly must rest on a factual basis, and these facts must be interpreted without hindsight reconstruction of the invention from the prior art. *In re Warner*, 154 USPQ 173, 178 (CCPA 1967). The Examiner may *not*, because he may doubt that the

invention is patentable, resort to speculation, unfounded assumptions, or hindsight reconstruction to supply deficiencies in his required factual basis. *Id.*

Claim 1 as representative of claims 1-12

In the final Office Action of May 7, 2008, the Examiner rejected claims 1-6, 12 and 13 under 35 USC §103(a) unpatentable over Funakubo in view of Watanabe et al, Barrett and Sarkar. This rejection was clearly based on the Examiner's incorrect and unsupported assertion that the prior art references teach more than one actuator element "extending between said fixed support and said sample stage" as "a means of causing displacement of the sample stage." Applicants controvert this rejection on several bases.

In that final Office Action, the Examiner asserted at page 2 that the primary reference, Funakubo, taught a fast scanning stage for a scanning probe microscope, the scanning probe microscope including a probe, the fast scanning stage comprising, a fixed support, and a sample stage having at least one axis of translation relative to the probe. On pages 2-3 of the final Office Action, the Examiner acknowledged that Funakubo does not teach the specific claimed bias voltage applied to actuate the stage; the specific kind of microscope used in the system; that the resonant frequency of the microscope is between about 500 Hz and 5 kHz; or the use of multiple actuator elements between the fixed support and the sample stage. The Examiner then cited Watanabe et al, Barrett, and Sarkar to address these omissions in the teachings of Funakubo. However, while the secondary Watanabe et al reference, the secondary Barrett reference and the secondary Sarkar reference disclose scanning tunneling microscopy, a scanning probe microscope and the manipulation of a stage, respectively, these references are otherwise unrelated to the microscope of Funakubo.

The reasons given by the Examiner in the final rejection for combining the reference teachings are clearly makeweight, and conveniently mischaracterize the nature of the references to facilitate their combination. The combination of Funakubo, Watanabe et al, Barrett and Sarkar is made possible only through impermissible hindsight review of the references, and a self-serving interpretation of their disclosures. That is, the Examiner has effectively used applicants' claims as a blueprint for the proposed combination. However, the Examiner is not

entitled to use a claim as a shopping list of elements which are to be located in diverse prior art references and then combined with no reason.

The invention itself, as delineated in the claims, may not be used as a template to find separate, individual elements in the prior art, and then to combine the elements and pronounce the combination obvious. The United States Supreme Court addressed the proper standards to combine references under 35 U.S.C. 103 in *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 167 L.Ed.2d 705, 82 USPQ2d 1385 (2007). The Court, while disapproving a strict application of the Federal Circuit's "TSM" (teaching, suggestion or motivation) test for determining whether it would have been obvious to combine references under 35 U.S.C. §103, adopted an objective standard in which all of the facts and circumstances associated with the invention and the prior art are considered. In point of fact, the Supreme Court cited with approval Federal Circuit cases adopting a more flexible TSM standard, and reaffirmed the standards for obviousness set out in *Graham v. John Deere*, 383 U.S. 1, 148 USPQ 459 (1966). Judged in this light, the claimed invention cannot be said to be an obvious combination of the teachings of the references.

The Examiner concluded on pages 2-3 of the May 7, 2008 Office Action that it would have been obvious to one having ordinary skill in the art to "use a voltage less than 100 volts" as taught by Watanabe in Funakubo "to drive the stage at the desired amplitude and to reduce power consumption." Additionally, the Examiner asserted that it would have been obvious "to incorporate the system of Funakubo in an atomic force microscope as taught by Watanabe, in order to maximize imaging resolution." The Examiner further asserted that it would have been obvious to "make the resonant frequency of the microscope of Funakubo in view of Watanabe to be between about 500 Hz and 5 kHz" as taught by Barrett "in order to choose the a [sic] resonant frequency appropriate to the measured sample and desired mechanical response." Finally, the Examiner asserted that it would have been obvious to modify Funakubo in view of Watanabe and Barrett "by attaching multiple actuators to the stage" as taught by Sarkar "in order to enhance movement and stability of the stage."

Applicants initially will address the Examiner's proposed combination of Sarkar and Funakubo in view of Watanabe and Barrett. Sarkar is directed to producing fully decoupled movement of a microstage in both the X and Y directions simultaneously (see Abstract and claim

1). Sarkar teaches actuator elements (Fig. 2, elements 203a-d) coupled to flexures (Fig. 2, elements 201a-d). The flexures are then connected to the microstage (Col. 2, lines 55-56; Col. 4, lines 12-13; Fig. 2, elements 202). Sarkar teaches that both the actuators and flexure elements are driven in opposition along the axis of motion. However, there is no teaching or suggestion in Sarkar of having more than one actuator element "extending between said fixed support and said sample stage" as "a means of causing displacement of the sample stage" as claimed. Thus, any combination of Funakubo and Sarkar would not result in the subject matter claimed in claims 1-12.

Further, there is nothing in Sarkar which would suggest to one of ordinary skill in the art to replace the single actuator in Funakubo with multiple actuators. Sarkar requires flexure elements coupled to a stage. Nothing in Sarkar would lead one to conclude that using multiple actuators in Funakubo would be reasonably successful.

While the Examiner asserted at page 3 of the May, 7, 2008 Office Action that one would use the multiple actuators in Sarkar "to enhance movement and stability of the stage," this does not provide sufficient motivation for one of ordinary skill in the art to substitute the multiple actuators and flexure elements of Sarkar for the single actuator of Funakubo. Nothing in Sarkar teaches the use of multiple actuators extending directly between the fixed support and the sample stage to cause displacement of the stage as taught in the present claims and as discussed in the present Specification (see paragraph [0014], page 5, lines 9-11; paragraph [0024], page 7, lines 19-22; paragraph [0027], page 8, lines 15-24) would "enhance movement and stability of the stage." This is especially true considering that Sarkar relies on the flexures, not the actuators, to stabilize and anchor the stage (see Fig. 2).

Additionally, the Examiner asserted on page 12 of the May, 7, 2008 Office Action that "the fact Sarkar disclosures flexures between the actuator elements and the stage is inconsequential." Applicants respectfully disagree. As discussed above, Sarkar's purpose is to produce fully decoupled movement of the microstage in both the X and Y directions simultaneously. Sarkar requires the use of both actuators and flexure elements driven in opposition along the axis of motion. In contrast, applicants do not use flexure elements, but instead, use a means (i.e., the actuators) driven in phase and directly coupled between a fixed

support and a sample stage. Thus, the requirement to use flexures in Sarkar is of consequence since the flexures are critical for the displacement of that stage.

Therefore, the advantage of more than one actuator element "extending between said fixed support and said sample stage" as "a means of causing displacement of the sample stage" is neither taught nor suggested by the prior art. Accordingly, one of ordinary skill in the art would not be motivated to substitute the multiple actuators of Sarkar for the single actuator of Funakubo because Sarkar itself teaches that that use of actuators alone will not work. Therefore, Sarkar teaches away from more than one actuator element "extending between said fixed support and said sample stage" as "a means of causing displacement of the sample stage." The United States Supreme Court in its *KSR* decision reaffirmed *United States v. Adams*, 383 U.S. 39, 51-52, 148 USPQ 479, 483-84 (1966) stating that "when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." Nor is there anything in Funakubo which suggests using more than one actuator element "extending between said fixed support and said sample stage" as "a means of causing displacement of the sample stage."

Further, there is also nothing in the Watanabe and Barrett references which teaches or suggests using more than one actuator element "extending between said fixed support and said sample stage" as "a means of causing displacement of the sample stage." Watanabe teaches at least two elements joined together by holding elements that form a connection between the base and sample holder (see Col. 8, lines 24-46; Col. 9, lines 60-68; Figs. 1, 2 and 6) and Barrett teaches tubular scanners positioned at the corners of a scanning stage to provide movement in the z-direction (see Col. 3, lines 25-44; Fig. 1).

In addition, on page 3 of the final Office Action of May 7, 2008, the Examiner asserted that it would have been obvious to use the an atomic force microscope as taught by Watanabe in Funakubo "in order to maximize imaging resolution." However, this combination of references does not provide sufficient motivation for one of ordinary skill in the art to substitute the atomic force microscope of Watanabe for the fast atomic force microscope of Funakubo. Nothing in Watanabe teaches the use of a fast atomic force microscope as taught in the present claims and as discussed in the present Specification (see paragraph [0013], page 4, line 24; paragraph [0034], page 11, lines 1-2) would "maximize imaging resolution."

The Examiner further asserted on page 3 of the May 7, 2008 Final Office Action that it would have been obvious to "make the resonant frequency of the microscope of Funakubo in view of Watanabe to be between about 500 Hz and 5 kHz" as taught by Barrett "in order to choose the a [sic] resonant frequency appropriate to the measured sample and desired mechanical response." However, the teaching of a single resonant frequency of 2 kHz in Barrett fails to offer a choice of "a resonant frequency appropriate to the measured sample and desired mechanical response." Nothing in Barrett teaches the use of a resonant frequency other than 2kHz. This is in contrast to the choice of "a scanning stage resonance frequency between about 500 Hz to about 5 kHz" as taught in the present claims and as discussed in the present Specification (see paragraph [0006], page 2, line 20; paragraph [0016], page 5, lines 26-28; paragraph [0035], page 11, lines 22-23). The range of scanning stage resonance frequencies presented in the present claims would allow for the choice of "a resonant frequency appropriate to the measured sample and desired mechanical response."

Therefore, applicants submit that the Examiner has failed to establish a prima facie case of obviousness by failing to provide the required evidence and reasoning to combine the reference teachings in the manner proposed. Even if combined, the reference teachings still fail to teach the subject matter recited in claims 1-12.

Claim 13 as representative of claims 13 and 15

With respect to the rejection of claim 13, applicants hereby repeat and incorporate by reference the arguments made above with respect to the Examiner's combination of Funakubo, Watanabe, Barrett and Sarkar for claims 1, 2, 4 and 12. On page 7 of the final Office Action of May 7, 2008, the Examiner asserted that Funakubo taught a method of operating a fast scanning stage for a scanning probe microscope, the scanning probe microscope including a probe, providing a sample stage having a sample thereon and causing displacement of the sample on the sample stage relative to the probe by actuating at least one actuator element to drive the stage at the resonant frequency of the sample stage using a sine waveform generator. On pages 7-8 of the final Office Action, the Examiner acknowledged that Funakubo does not teach the specific claimed bias voltage applied to actuate the stage; the specific kind of microscope used in the system; that the resonant frequency of the microscope is between about 500 Hz and 5 kHz; or the

use of multiple actuator elements between the fixed support and the sample stage. The Examiner then again cited Watanabe et al, Barrett, and Sarkar to address these omissions in the teachings of Funakubo.

The method in Sarkar, as discussed above, is directed to producing fully decoupled movement of a microstage in both the X and Y directions simultaneously (see Abstract and claim 1). Sarkar teaches actuator elements (Fig. 2, elements 203a-d) coupled to flexures (Fig. 2, elements 201a-d). The flexures are then connected to the microstage (Col. 2, lines 55-56; Col. 4, lines 12-13; Fig. 2, elements 202). Sarkar requires the use of both actuators and flexure elements driven in opposition along the axis of motion. The requirement to use flexures in Sarkar is critical for the displacement of that stage. In contrast, applicants do not use flexure elements to cause displacement of the sample stage, but instead, use actuators extending between said sample stage and a fixed support that are driven in phase to displace the stage. There is no teaching or suggestion in Sarkar of a method that "causing displacement of .... said sample stage relative to said probe by actuating actuator elements extending between said sample stage and a fixed support." Thus, any combination of Funakubo and Sarkar would not result in the subject matter claimed in claims 13 and 15.

Further, there is nothing in Sarkar which would suggest to one of ordinary skill in the art to replace displacing the stage with the single actuator in Funakubo with displacing the stage with multiple actuators. Sarkar requires flexure elements coupled to a stage to cause displacement of the stage. Nothing in Sarkar would lead one to conclude that using multiple actuators for displacement in Funakubo would be reasonably successful.

Therefore, the advantage of the method of "causing displacement of .... said sample stage relative to said probe by actuating actuator elements extending between said sample stage and a fixed support" is neither taught nor suggested by the prior art. Accordingly, one of ordinary skill in the art would not be motivated to substitute actuating the multiple actuators of Sarkar for actuating the single actuator of Funakubo because Sarkar itself teaches that actuating the actuators alone will not work. Therefore, Sarkar teaches away from causing displacement of the sample stage by actuating more than one actuator element "extending between said fixed support and said sample stage." The United States Supreme Court in *KSR* reaffirmed *United States v. Adams*, 383 U.S. 39, 51-52, 148 USPQ 479, 483-84 (1966) stating that "when the prior art

teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious." Nor is there anything in Funakubo which suggests causing displacement of the sample stage by actuating more than one actuator element "extending between said fixed support and said sample stage."

Further, there is also nothing in the Watanabe and Barrett references which teaches or suggests the method of "causing displacement of .... said sample stage relative to said probe by actuating actuator elements extending between said sample stage and a fixed support." Watanabe teaches a method of driving at least two elements joined together by holding elements that form a connection between the base and sample holder (see Col. 3, lines 29-43; Col. 8, lines 24-46; Col. 9, lines 60-68; Figs. 1, 2 and 6) and Barrett teaches positioning tubular scanners at the corners of a scanning stage and activating the scanners to provide movement in the z-direction (see Col. 3, lines 25-44; Fig. 1). Therefore, the Examiner has pointed to no reference which teaches the method of "causing displacement of .... said sample stage relative to said probe by actuating actuator elements extending between said sample stage and a fixed support."

Therefore, applicants submit that the Examiner has failed to establish a prima facie case of obviousness by failing to provide the required evidence and reasoning to combine the reference teachings in the manner proposed. Even if combined, the reference teachings still fail to teach the subject matter recited in claims 13 and 15.

Conclusion

Applicants respectfully submit that there are clear errors in the rejections to claims 1-13 and 15 maintained from the previous Office Action dated May 7, 2008, and that essential elements to establish a *prima facie* case of obviousness have not been met. In particular, as discussed in detail above, the cited references do not disclose all the limitations of the rejected claims.

Therefore, it is submitted that the claims pending in the instant application are allowable. The Board is respectfully requested to reverse all the rejections made by the Examiner in their entirety.

Respectfully submitted,

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KES/AMM

CLAIMS APPENDIX

1. A fast scanning stage for a scanning probe microscope, said scanning probe microscope including a probe, said fast scanning stage comprising, a fixed support, and a sample stage having at least one axis of translation, said sample stage being affixed to said fixed support by means for causing displacement of said sample stage relative to said probe, wherein said means for causing displacement comprises actuator elements extending between said fixed support and said sample stage and wherein said means for causing displacement is responsive to the application of a bias voltage of 100 volts or less and wherein said scanning probe microscope is a fast atomic force microscope (AFM) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz.

2. A fast scanning stage for a scanning probe microscope, said scanning probe microscope including a probe, said fast scanning stage comprising a fixed support and a sample stage having at least one axis of translation, said sample stage being affixed to said fixed support by means for causing displacement of said sample stage relative to said probe, and in which said means for causing displacement of said sample comprises actuator elements extending between said fixed support and said sample stage and a sine waveform generator for actuating said actuator elements through the application of a bias voltage of 100 volts or less, wherein said scanning probe microscope is a fast atomic force microscope (AFM) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz.

3. A fast scanning stage as claimed in claim 2 in which said means for causing displacement of said sample stage comprise four actuator elements supporting said sample stage.

4. A fast scanning stage for a scanning probe microscope, said scanning probe microscope including a probe, said fast scanning stage comprising a fixed support and a sample stage having at least one axis of translation, said sample stage being affixed to said fixed support by actuator elements extending between said fixed support and said sample stage, a sine waveform generator for actuating said actuator elements, in which said sample stage is displaced by said actuator

elements being driven at the frequency of resonant vibration through the application of a bias voltage of 100 volts or less corresponding to translation of said sample stage with respect to said probe, wherein said scanning probe microscope is a fast atomic force microscope (AFM) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz.

5. A fast scanning stage as claimed in claim 4 in which said sample stage has a square or rectangular configuration and each corner of said sample stage is supported by one of said actuator elements.

6. A fast scanning stage as claimed in claim 5 in which said actuator elements form a parallelogram scanning element.

7. A fast scanning stage as claimed in claim 6 in which said actuator elements are connected electrically in parallel.

8. A fast scanning stage as claimed in claim 2 in which at least one of said actuator elements comprises a stack bending element.

9. A fast-axis scanning stage as claimed in claim 2 in which at least one of said actuator elements comprises a PZT bimorph.

10. A fast-axis scanning stage as claimed in claim 3 in which at least one of said actuator elements comprises a PZT bimorph.

11. A fast-axis scanning stage as claimed in claim 1 in which said sample stage is comprised of a material selected from the group consisting of ceramics, heat resistant polymers, and anodized aluminum.

12. A scanning probe microscope including a probe and a fast scanning stage, said fast scanning stage comprising a fixed support, and a sample stage having at least one axis of

translation, said sample stage being affixed to said fixed support by actuator elements extending between said fixed support and said sample stage and supporting said sample stage to cause displacement of said sample stage relative to said probe through the application of a bias voltage of 100 volts or less, wherein said scanning probe microscope is a fast atomic force microscope (AFM) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz.

13. A method of operating a fast scanning stage for a scanning probe microscope, said scanning probe microscope including a probe, said method comprising, providing a sample stage having a sample thereon and causing displacement of said sample on said sample stage relative to said probe by actuating actuator elements extending between said sample stage and a fixed support, wherein said actuator elements drive said sample stage at the resonant frequency of said sample stage using a sine waveform generator through the application of a bias voltage of 100 volts or less, wherein said scanning probe microscope is a fast atomic force microscope (AFM) with a scanning stage resonance frequency between about 500 Hz to about 5 kHz.

15. A method as claimed in claim 13 in which the resonant frequency of said sample stage is about $1/100^{th}$ that of the resonant frequency of said probe.

EVIDENCE APPENDIX

NONE

RELATED PROCEEDINGS APPENDIX

This application was the subject of a prior appeal filed via First Class Mail on June 21, 2006, US Patent Office Mail Room date June 27, 2006, and as a result prosecution was re-opened, see Non-Final Rejection mailed July 20, 2006, therefore no decision was rendered by the Board.